2018

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Published in *Population Research and Policy Review* (2018)
doi 10.1007/s11113-018-9476-2

Submitted 18 July 2017; accepted 26 June 2018; published 2 July 2018.

Fertility and Infertility: Toward an Integrative Research Agenda

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Abstract

In this article, we show that social science research on fertility and infertility consists of largely separate research traditions, despite shared interest in pregnancies and births (or lack thereof). We describe four ways these two traditions differ: (1) publication trajectories and outlets, (2) fields of study and major theoretical frameworks, (3) degree of attention to the other topic, and (4) language and definitions used. We then discuss why future integration of these bodies of research would be beneficial, outline potential steps toward rapprochement, and provide common areas of dialogue that could facilitate and enrich these bodies of research. We offer a more holistic framework using the *reproductive career* as an extension of existing lifecourse approaches in both fertility and infertility research. We conclude with a brief empirical example and discussion of methodological issues for measuring and modeling reproductive careers.

Keywords: Fertility, Infertility, Lifecourse, Reproductive career, Reproduction

Introduction

Although social science research on fertility and infertility focuses on related outcomes– pregnancies and births, or lack thereof—these bodies of research have historically constituted two distinct traditions with differing foci, theoretical frameworks, concepts, and definitions. This divergence may seem surprising given their inherent interconnections. Indeed, van Balen and Inhorn (2002, p. 7) have argued that infertility and fertility should be viewed as dialectically connected via "a relationship of tension and contrast [...] on both the microsociological level of individual human experience and the macrosociological level of reproductive politics." Why are fertility and infertility studies siloed from one another? How might we better understand, or create, interconnections between these bodies of work? In this paper, we first outline four notable differences between the demographic study of human fertility and the sociological study of infertility. We then discuss three primary benefits of a more integrative research agenda: merging the strengths of each approach, creating a springboard for new research questions and concepts, and making models and theories better match the reality of human reproduction. We next point to common dialogues occurring in both fields: changing fertility trends, understanding fertility intentions, and the role of men in reproduction. We further suggest a path for conceptual integration via a *reproductive career* approach. Finally, we examine preliminary empirical support for this framework and point to methodological possibilities and limitations.

Fertility and infertility have various colloquial and research-specific meanings. By "fertility," we refer to "the incremental processes by which living members of a population produce live births" (Preston et al. 2001, p. 92). By "infertility," we refer to both the dominant Western biomedical definition—no conception within 12 months of having unprotected, heterosexual sex (ASRM 2008)—as well as subjective definitions, which include a sense of self as having a fertility problem, whether or not one has a medical condition, or not reaching fertility expectations for (additional) children because of biological or social barriers (Greil et al. 2011; Johnson et al. 2014; Leyser-Whalen et al. 2018; Sundby 2002).

Differences in Fertility and Infertility Research

Publication Frequency, Trajectories, and Outlets

One key difference between infertility and fertility research is the frequency of publications and outlets publishing this work. Given that our purpose here is to examine the interplay between sociological and demographic research, we codified our impressions through citation searches in *Sociological Abstracts*. For infertility research, we used the search string: "infertility," "subfecund," "sterility," and "involuntary childless." For fertility research, we used the search string: "fertility," "birth," and "fecund." These terms have clear counterparts (in/fertility, sub/fecund, fertility/ sterility), and they generally describe the phenomena of interest. This focus and choice of search index necessarily excludes or restricts coverage of certain fields (e.g., anthropology, gender studies) or topics (e.g., childbirth); however, our intent was not to be exhaustive. Other works have reviewed fertility and reproduction at the intersections of demography, anthropology, and feminist perspectives (Greenhalgh 1995; Ginsburg and Rapp 1991)

Until the 1950s, there was relatively little research published on either topic (Fig. 1). In the mid-1950s, there was a notable uptick in fertility publications, corresponding to the post-WWII interest in population growth and economic development (Szreter 1993). Another sharp increase in the 1980s likely flowed from the development of the European Fertility Project at Princeton, initiated by Ansley Coale in the 1960s, and the publication of a significant monograph: *The Decline of Fertility in Europe* (Coale and Cotts-Watkins 1986). Fertility research has consistently increased each decade since the 1950s.

Publications on infertility remained minimal, with a slight increase in the late 1980s roughly corresponding to the development of in vitro fertilization, egg donation, and surrogacy, and related controversies (Thompson 2002). A more sustained increase in the mid-1990s is likely related to the 1994 International Conference on Population and Development at Cairo, which recognized infertility prevention and treatment as part of a broader program of global reproductive health (Brady 2003). More than half of all articles were published after 2002, indicating that substantial social science interest in infertility is quite new.

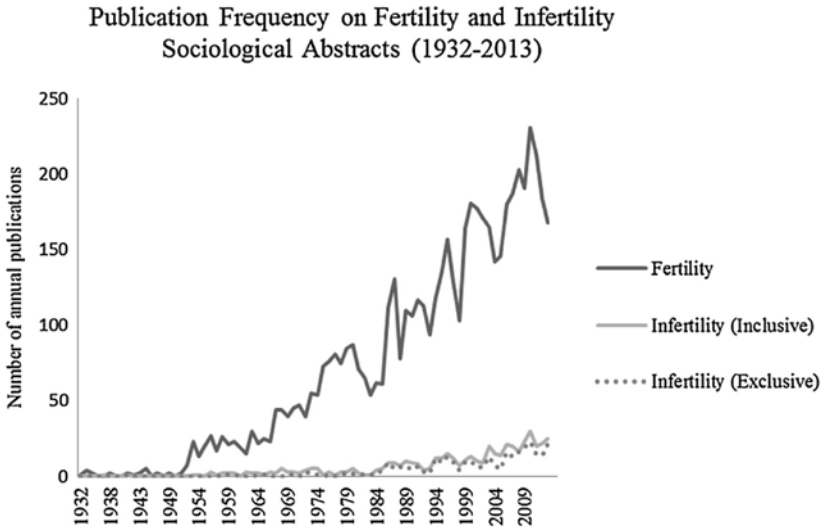

Fig. 1. Publication frequency on fertility and infertility, sociological abstracts (1932–2013). Infertility (inclusive) refers to all studies published that mention infertility anywhere in the text. Infertility (exclusive) refers to studies that explicitly focus on infertility as the main topic of analysis

Publication outlets also differ, signifying different scholarly audiences (Table 1). The top journal for infertility publications is *Social Science & Medicine*, whereas the top journal for fertility publications is *Population Studies*. The top five journals publishing infertility research specialize in medical/health sociology, sexual and reproductive health, bio-sociology, and demography. In contrast, four of the five the top outlets for fertility research are demographic. *Population Studies* and *Journal of Biosocial Science* rank in the top five for both, suggesting outlets for possible integration. Since 1932, however, there have been only 36 articles published on infertility in *Population Studies* compared to 585 articles on fertility. Similarly, *Journal of Biosocial Science* has published 263 articles on fertility compared to 20 on infertility.

Fields and Frameworks

Fertility and infertility research have also emerged from different disciplinary homes, influencing dominant perspectives and frameworks. Fertility research emerged predominantly from demography and family planning studies (Szreter 1993) and has been characterized by discerning, predicting, and explaining broad population trends in births, contraceptive use, unintended pregnancies, and fertility intentions.

Table 1. Top five publication outlets (sociological abstracts, 1932–2013)

Journal	*n*	*%*
Infertility (inclusive), n = 471		
1. Social Science & Medicine	51	10.8
2. Population Studies	36	7.6
3. Journal of Biosocial Science	20	4.2
4. Reproductive Health Matters	16	3.4
5. Sociology of Health & Illness	16	3.4
Total	139	29.5
Fertility n = 4715		
1. Population Studies	585	12.4
2. Population and Development Review	320	6.8
3. Journal of Biosocial Science	263	5.6
4. Demographic Research	221	4.7
5. Population Research and Policy Review	127	2.7
Total	1516	32.2

Infertility (inclusive) refers to all studies published that mention infertility anywhere in the text.

There has also been a major emphasis on measurement and modeling. Fertility researchers are universally familiar with such key measures as age-specific fertility rates (ASFR), total fertility rates (TFR), and demographic techniques such as life table analysis, population projections, and event history analysis.

Fertility research is characterized by core analytic frameworks and dominant theories of fertility behavior and change (Morgan and Hagewen 2006). Demographic transition theory has historically dominated demographic theories of fertility (Kirk 1996; Mason 1997). Later critiques and revisions have included ideational change (Lesthaeghe 1980), wealth flows (Caldwell 2005), microeconomic models (Becker 1960; Robinson 1997), diffusion/social interaction (Bongaarts and Watkins 1996), and the second demographic transition (Lesthaeghe 2010). Scholars have particularly emphasized the need to better theorize and empirically understand connections between fertility intentions and behavior (Bongaarts 2001, 2002; Schoen et al. 1999; Hayford 2009) and fertility decision making as a dyadic and extra-dyadic process (Miller and Pasta 1995; Thomson 1997). Two consistent overarching frameworks are the lifecourse approach (Elder et al. 2003; Morgan and Hagewen 2006) and the proximate determinants of fertility (Bongaarts 1978; Bongaarts and Potter 1983).

Infertility research was historically concentrated in medicine and medical psychology (Matthews and Martin Matthews 1986; van Balen and Inhorn 2002). Much work has been conducted with infertility clinics and concerned with the psychological distress of infertility and treatment, and identifying those in need of intervention (Greil 1997; van Balen 2002). Outside of medicine and medical psychology, social scientific infertility research has been quite eclectic theoretically; researchers have drawn on different sociological theories and frameworks, including feminist approaches (Thompson 2002), symbolic interaction (Leyser-Whalen et al. 2018; Miall 1986), and theories of health behavior and medical help-seeking (White et al. 2006), among others. Researchers have deployed a variety of mainstream sociological concepts such as marital dynamics (Greil 1991; Lorber and Bandlamudi, 1993), stigma (Miall 1986; Greil 1991), medicalization and medical markets (Almeling 2010; Becker and Nachtigall 1992; Johnson and Fledderjohann 2012; Martin 2009), ideologies of parenthood (Letherby 1999), and the intersections of race, class, gender, and sexuality (Agigian 2004; Barnes 2014; Bell 2014; Hertz 2006). Social scientists have viewed infertility not so much as a self-contained subject but rather as a "lens" for illuminating different aspects of social life (van Balen and Inhorn 2002). As a result, infertility research is methodologically and theoretically diverse and does not necessarily have a recognizable, core literature or perspectives. In contrast, fertility research has been described as an "advanced science [...] with agreed upon strategies of measurement and analysis, widely accepted frameworks [...] and widely accepted characterizations of phenomena" (Morgan and Hagewen 2006, p. 245). Notably, while infertility research is generally situated within the growing subfield of sociology of reproduction—giving it a stronger connection to mainstream sociological theory–demography and population studies remain largely outside of this subfield. At the same time, some demographic work, especially in social and family demography, has been more integrated with sociological theorizing; see especially Lesthaeghe's (1980, 2010) work on ideational change and the (weakening) social control of reproduction, Cherlin's (2004) deinstitutionalization perspective on American families, and more recent work on social change and family variations (Johnson-Hanks et al. 2011).

A broad impression of the fertility and infertility research also shows differences in epistemological approaches and methods used.

While both bodies of research tackle the connections between macro and micro-level issues, exploring how larger social forces might come to play in individual-level or dyadic attitudes and behaviors, they do so from different perspectives, often using different types of data. Fertility research has been a largely positivist endeavor from the beginning, characterized by quantitative analyses and a particular emphasis on cross-national or subgroup comparisons of fertility trends or broad-scale changes in fertility behaviors over time. Despite this, there has been some qualitative research. Bongaarts and Watkins' (1996) theory of social interaction for fertility transition points to the importance of "local channels" (i.e., personal networks) as a key site for diffusion of information shaping fertility preferences and behaviors. Thus, Watkins and Danzi (1995) explored the role of "women's gossip" in shaping reproductive behavior. Others have examined how reproduction and family planning are framed as women's responsibility (Agadjanian 2002; Fennell 2011), despite men's often overt or covert control over decisions to have (more) children in many cultures (Dodoo and Frost 2008).

In contrast, many infertility researchers are concerned with understanding how individuals cope with and make sense of infertility within different social and cultural contexts. Thus, much of this work emanated from a more interpretivist social science tradition, drawing on primarily qualitative methods of inquiry. Exceptions here include quantitative analyses of incidence/prevalence and unmet need for treatment (Frank 1983; Larsen 1994; Morgan 1991; Boivin et al. 2007), as well as a series of more recent studies documenting perception of infertility as a problem (Greil et al. 2010, 2011, 2016; Johnson and Fledderjohann 2012) and patterns of medical help-seeking (Greil and McQuillan 2004; Stephen and Chandra 2000; White et al. 2006). Even though fertility and infertility research tend to use different methods and epistemologies, both are incorporating new approaches over time.

Language and Definitions

There are also differences in the preferred language and definitions used in fertility versus infertility research (Table 2). Most social science researchers studying infertility recognize both medical and subjective definitions. Infertility is medically defined as the inability to

Table 2. Terms and definitions

Medical	***Demographic***	***Subjective***
Infertility 12 months of regular, heterosexual sex without conception (ASRM 2008). Includes delayed time to conception as well as inability to conceive	*Infertility* "inability of a noncontracepting, sexually active woman to have a live birth" (Larsen 2005)	*Infertility or impaired fecundity* Perceived difficulty conceiving/ carrying to term/ meeting fertility goals, regardless of medical/ demographic criteria (e.g., Leyser-Whalen et al. 2018; Sundby 2002)
	Subfecundity or infecundity reduced biological ability to have children (e.g., King 2003; Preston et al. 2001)	*Fertility barriers* "A range of both biological and social factors that prevent women and men from having *wanted* children" (Johnson et al. 2014)
	Sterility childless due to inability to conceive (e.g., Leridon 2008; Preston et al. 2001)	

conceive after at least twelve months of regular, unprotected, heterosexual intercourse (ASRM 2008)—for critiques of this definition see especially Greil and McQuillan (2010) and Johnson et al. (2014). The subjective definition emphasizes individual perception of having a fertility problem, regardless of medical indication. Research indicates some disconnection between definitions: some women self-identify without meeting medical criteria, while others meet the criteria but do not perceive it as a problem (Greil et al. 2011; Leyser-Whalen et al. 2018; White et al. 2006). Women may also "anticipate" future infertility because they expect to not meet reproductive goals due to career or educational demands (Martin 2010) or consider themselves to have "reproductive failure" because they have not yet met overall fertility goals (Sundby 2002). Researchers also point to medical versus social terms to define the problem, namely, infertility versus involuntary childlessness (Letherby 1999). To reconcile these differences, Johnson et al. (2014) proposed using "fertility barriers," defined as "a range of both biological and social factors that prevent women and men from having *wanted* children" (p. 24). This incorporates medical, social, and subjective approaches under the same umbrella term,

but still allows for comparisons among subgroups (e.g., unable to conceive due to social reasons such as lack of heterosexual partner versus unable to conceive because of a biomedical problem). Greil et al. (2010, 2011) also use the term "infertility episode" to emphasize the fact that (medically defined) infertility may not be a permanent condition. Infertility may continue over months or years, but also be woven among other reproductive states or events such as pregnancy, miscarriage, abortion, or live birth, thus having an episodic quality in contrast to being a permanent state.

If fertility refers to "live births" (Preston et al. 2001), infertility is naturally an antonym, referring to the absence of a(nother) birth. Indeed, Larsen (2005, p. 846) noted that "infertility" is usually defined demographically as "the inability of a non-contracepting, sexually active woman to have a live birth." In contrast to the medical definition, the demographic emphasis is on the inability to have a(nother) live birth rather than the inability to conceive. Because the chief concern of fertility research is understanding fertility behavior rather than the emotional and social consequences of infertility, available data also typically use a three-, five-, or sevenyear period of intercourse without a live birth to denote infertility (Larsen 2005; Rutstein and Shah 2004). Demographic research also has its own terms to describe phenomena that inhibit or reduce fertility. This includes more temporary forms of "infecundity" or "subfecundity" as well as the more enduring or permanent state of "sterility" (Preston et al. 2001; Leridon 2008). "Sterility" is often measured by the proxy of married women being zero-parity at the end of their reproductive years; the demographic terms "subfecundity" or "infecundity" are typically more in line with the clinical definition of "infertility" (King 2003; Preston et al. 2001), indicating a reduced capacity to conceive, but not necessarily permanent inability. These slight differences in terminology and definitions make sense for different research traditions relying on different sources of data and different issues of measurement (e.g., recall, cultural differences in perceptions of infertility), but they also pose a barrier to integration. We do not advocate the primacy of one definition of infertility. We suggest that researchers can use the framework in Table 2 to think more about where their particular definition fits within the broader discussion of infertility as a medical condition, demographic issue, and

subjective experience. For instance, we frequently use the medical definition in our work (as reflected below) as a way to select an analytic sample. This does not mean that we privilege this definition or view it as unproblematic [see Greil and McQuillan (2010) and Johnson et al. (2014) for critiques beyond the scope of this paper]. However, this definition offers precise and bounded criteria for sample selection, from which to then explore topics such as the disjuncture between medical criteria and subjective perception.

Attention toward the Other

The two bodies of research also differ regarding attention paid to each other. In the classic proximate determinants of fertility framework (Bongaarts 1978, 2001, 2002; Bongaarts and Potter 1983), eight intermediate variables impact fertility outcomes. Three are relevant to infertility or fertility problems: intrauterine mortality, sterility (inability to conceive), and duration of the fertile period in a woman's menstrual cycle. Bongaarts (1978) asserted that these variables, however, are "not of importance for explaining differences in fertility among populations unless venereal disease [which can lead to infertility] is present" (p. 119). Indeed the prevalence of 12-month, medically defined infertility typically may not have a significant, mathematical impact on overall population dynamics, unless there is some widespread epidemic of STIs affecting fecundity. While this may hold up in cross-sectional analyses, our work with the National Survey of Fertility Barriers (NSFB) data (more below) shows a lifetime infertility prevalence of 47.1% among US women aged 25–45, assessing whether women have ever met the 12-month medical definition (ASRM 2008). This included both primary and secondary forms of infertility, as well as women who were trying to conceive, not trying to conceive, and who were "ok either way." Global estimates, also using a 12-month medical definition, show a median infertility prevalence of 9%, but this also ranges from 3.5 to 16.7% across nations (Boivin et al. 2007). Thus the macro-level importance of infertility is notably under-played without more longitudinal and cross-national analyses. Additionally, while infertility may not have a notable mathematical effect for overall TFR, it may work in more subtle ways by impacting fertility intentions and starting, spacing, and stopping behaviors.

Some fertility scholars have conducted more direct analyses of infertility by analyzing childlessness trends and attempting to parse out voluntary from involuntary factors (Morgan 1991; Rowland 2007). Fertility research on Sub-Saharan Africa often references the "infertility belt": countries in southern and central Africa with the highest fertility *and* infertility rates in the world (Feldman-Savelsberg 2002; Frank 1983; Frank and McNicoll 1987; Larsen 1994). Addressing and alleviating infertility, however, is often low priority in developing countries because of the emphasis on lowering fertility and lack of resources for providing treatment (Daar and Merali 2001). Fear of infertility in high-fertility societies may create a strong desire to have (many) children to prove fertility. Thus, some have argued that it will be impossible to limit fertility in high-fertility societies until (fear of) infertility has diminished (Frank 1983; Okonofua et al. 2004). Researchers addressing low fertility in Europe have begun to question how delayed parenthood, age-related infertility, and assisted reproduction might influence completed fertility rates (Schmidt et al. 2012; Sobotka et al. 2008). Schmidt et al. (2012) reviewed findings showing that reduction in completed fertility rates ranged between 1.6 and 11.7% across different European countries, depending on how long individuals delayed first or second births. They ultimately argued that even widespread access to assisted reproduction could not "fully compensate" for potentially lost fecundability due to postponing parenthood and age-related infertility.

In contrast to its relatively marginal or indirect role in fertility research, infertility research necessarily takes *failed fertility* as its central problem. In most studies, the contextual starting point is normative expectations for childbearing (timing, spacing, and desired family size) in order to understand the psychosocial consequences when reproduction does not go as intended. Scholars have addressed infertility variously as a "lifecourse disruption" (Becker 2000; Exley and Letherby 2001), a "transition to non-parenthood" (Matthews and Martin Matthews 1986), and as leading to a "spoiled identity" (Greil 1991), because it may block the desired status attainment of biological parenthood. As a result, infertility researchers have more often incorporated a dialectical approach in their work, implicitly and explicitly observing that infertility cannot be understood without addressing fertility norms and behaviors.

Toward Integration?

Benefits of Integration

Taken together, the differences mentioned above suggest that different agendas drive research on fertility and infertility. If so, should there be a more integrative research agenda? We argue that such integration can serve mutually beneficial purposes by (1) merging the strengths of each approach, (2) creating a springboard for new research questions and concepts, and (3) making models and theories better match the reality of human reproduction.

Merging Strengths

Fertility and infertility research have different strengths. In particular, the former offers a consistent set of well-established frameworks with agreed-upon measures of constructs/variables, a more cohesive, developed body of work, and the ability to make comparisons over time and cross-nationally. Demographic research has been successful at such comparisons despite the fact that scholars work in a variety of disciplines (sociology, rural sociology, economics, anthropology, and public health, among others). These strengths could particularly benefit thinking through how best to approach the estimation of 12-month infertility prevalence and unmet need for treatment at national and global levels.

Infertility research does not have established frameworks, but offers a rich understanding of how cultural and social values infuse childbearing and even influence how/whether individuals come to perceive a fertility barrier as a problem. With its strong use of sociological concepts and theories on culture, family, inequality, and technology (among others), it maintains a more integrated relationship with the broader sociological literature. These strengths could particularly benefit fertility research with understandings of how contraceptive technologies and family planning programs are received by local cultures and communities, and how population policies are imbued with cultural values that may not translate cross-nationally. Furthermore, infertility research emphasizes how the meaning of in/fertility is inherently connected to gender identity and other forms of social belonging (e.g., race/ethnicity, religious communities). These insights can help strengthen and extend existing demographic theories and

approaches, as well as put demographic work on human fertility in more direct conversation with mainstream sociological theory.

Springboard for Future Research

An integrated in/fertility framework can also serve as a springboard for shedding new light on each phenomenon as well as human reproduction more holistically. Seeking to understand population fertility rates without considering infertility prevalence (12-month or longer periods) will be incomplete, and studying the social and behavioral responses to infertility without the broader context of fertility histories and desires will be insufficient. An integrated framework can provoke new research questions and present new theoretical possibilities. How do women who have had various infertility episodes or reproductive loss experiences respond to questions about fertility intentions? Are they more reluctant to form concrete future intentions in the face of reproductive difficulties? How do women and couples with a history of unintended or unwanted pregnancies respond to an episode of infertility? How does the combination of various in/fertility events relate to the timing of other transitions (e.g., union formation) across the lifecourse? How will continued fertility postponement affect medical and/or demographic infertility rates? How much influence does infertility have on total fertility rates and completed fertility, and might its influence increase over time? Does this vary by subgroups (e.g., race, socioeconomic status, sexual orientation)? These are all important questions that point to the dialectical connection between fertility and infertility and the value of thinking about in/fertility across the lifecourse.

Better Match with Reality

Integration of in/fertility research will also help to produce conceptual and empirical models that better match the reality of human reproduction as it is experienced. As we argue in greater detail below, examining reproduction as a series of discrete events (births, 12-month infertility, unintended pregnancy, abortion) will necessarily produce only partial understandings of those events. A more realistic approach is to see how these various events are contingent and connected across the lifecourse.

Shared Conversations and Frameworks

How do we move toward integration? Below, we focus on possibilities for integration by discussing three areas of overlap in fertility and infertility research: (1) changing fertility trends, (2) the importance of fertility attitudes and intentions, and (3) the role of men in reproduction. Then we discuss the reproductive careers framework as an extension to existing lifecourse approaches.

Changing Fertility Trends

In the US, the age at first birth has been increasing over the last few decades (Dye 2010; Rindfuss et al. 1996). While this shift has occurred among all racial/ethnic groups, it is more pronounced for non-Hispanic White women and women of a higher socioeconomic status (Dye 2010; Sweeney and Raley 2014). This trend is connected to women's increased educational and employment opportunities and the incompatibility between such opportunities and childbearing (Rindfuss et al. 1996). The notable increase in women delaying first births until age 30 or later has caused many scholars to consider how this contributes to changes in overall fertility rates and age-related infertility. Although more women are delaying first births, the percentage of women ending childbearing years without having a child has decreased from 20% in 2006 to almost 14% in 2016 (Livingston 2018). At the same time, focusing on the outcome (birth) can obscure the means it took to conceive at later ages. Stephen (2000, p. 310) observed that increased fertility among older women, especially aged 40–49, "has definitely been enhanced" by assisted reproduction. Others warn that technologies are not a "cure-all" (Maheshwari et al. 2008), despite widespread faith in Western medicine (Earle et al. 2008), and that women are playing "reproductive roulette" if they delay fertility too long (McFalls 1990). Although women are quite aware of age-related infertility, beliefs in the efficacy of medical science may cause them to delay without fear, creating a disjuncture between ideal and actual family size.

Two other trends are relevant to a lesser extent: the rise in non-marital births and the increasing rates of multiple births. Non-marital birth rates have increased for all racial/ethnic groups, and cultural attitudes have become more accepting in recent decades (Musick 2002; Sweeney and Raley 2014). Non-marital birth rates have long

been higher among lower SES and non-white women. Against this backdrop, there is growing sociological interest in single mothers by choice (SMCs)—women who intentionally seek out childbearing in the absence of a desired or suitable partner (Hertz 2006). This trend subverts traditional understandings of single motherhood as unintended, as most women who are intentional single mothers have access to a greater array of social and financial resources and actively work to conceive without a partner. We must also keep in mind that that many incidences of "single" motherhood occur in non-marital partnerships (Sweeney and Raley 2014) including both heterosexual and same sex couples (Agigian 2004) and that many unmarried couples may have intended those pregnancies.

A third, though less common, fertility trend is the increase in multiple birth rates. Because they are rarer, infertility treatments have strongly impacted these rates since the 1970s (Stephen 2000). Women using in vitro fertilization often have higher rates of multiple births because physicians typically transfer multiple embryos to ensure a successful pregnancy (Dickey 2007). Although most twin births (63–73%) are naturally conceived, higher-order multiple births (HOMB) are less often from natural conception (17.6–19.5%) (Dickey 2007). Between 1990 and 2006, the triplet birth rate doubled from 71.6 to 143.4 per 100,000 births and the HOMB rate for quadruplets and higher increased from 5 to 9.89 per 100,000 births (Martin et al. 2009). Although medical practitioners aim to reduce multiple birth outcomes, patients frequently desire multiples (Gleicher et al. 1995; Ryan et al. 2004). This does not necessarily reflect a change in desired family size, but in spacing preferences–especially for older women who have a shorter reproductive lifespan and those who have been infertile for longer periods. How much has assisted reproduction contributed to nonmarital and multiple births? Without more comprehensive national reporting, it is difficult to gage. Recent estimates indicate that assisted reproductive technology was used for approximately 1.5% of all U.S. births in 2011, but this varies by state: it contributed to as much as 4.5% of 2011 births in Massachusetts (Sunderam et al. 2014).

Fertility Attitudes and Intentions

A second topic relevant to both fertility and infertility research is fertility attitudes and intentions. Fertility research has explicitly studied

and theorized intentions visa- vis fertility behavior. In Coale's (1973) classic statement on fertility transition, two of three necessary preconditions for fertility decline referenced intentions: first, that fertility be within "the calculus of conscious choice" for people, and second, that lower fertility be perceived advantageous enough to motivate behavior. Demographic research distinguishes between fertility preferences (including ideals and desires), intentions, and expectations, (Casterline and El-Zeini 2007; Morgan and Hagewen 2006), although empirically capturing these distinctions is difficult. Preferences typically refer to lifetime fertility goals; survey respondents may engage in a "hypothetical exercise" when asked, "How many children do you want (overall)?" (Morgan and Hagewen 2006, p. 237). Intentions indicate plans or goals for actual fertility and are assumed to be linked more closely to fertility behavior, but research suggests this is an imperfect proxy (Morgan 2001; Morgan and Rackin 2010). Surveys vary widely in whether they specify a time period and what time period is offered for consideration (e.g., how many children do you want…*in the next five years*?), which can influence how much attitudinal measures correspond with actual behaviors. Expectations are most specific to an individual's current situation and "invite … a consideration of impediments that might interfere with one's intentions" (Morgan and Hagewen 2006, p. 237). Demographic researchers historically treated fertility intentions as stable "state-like" traits of an individual, but later thinking and empirical evidence indicates that women change their fertility intentions over the lifecourse with changing social contexts (Hagewen and Morgan 2005; Hayford 2009; Shreffler et al. 2015). For younger women, social norms concerning family size and general preferences may be key determinants of intentions, but practical considerations and constraints exert more influence as women progress through the lifecourse. Intentions can be conceptualized as both "highly contingent" on period factors and "highly constrained" by biological factors, structural factors, and social norms about childbearing and completed family size (Morgan and Rackin 2010).

Past infertility research rarely considered the relevance of fertility intentions. A strong assumption was that everyone classified as medically infertile intended to have a child (Greil et al. 2010; Greil and McQuillan 2010). This likely stems from the fact that much prior research was based on clinical samples; people seeking medical treatment for infertility are especially motivated to have children (Greil

1997; Sandelowski 1993). But not getting pregnant within a medically specified window of time does not automatically lead to a "disrupted lifecourse" (Exley and Letherby 2001). To make sense of the women who are "okay" with the lack of conception from unprotected intercourse, we need to consider fertility preferences, expectations, and intentions. As prior fertility research on the Knowledge-Attitudes-Practice (KAP)-gap has shown (Bongaarts 1991), we cannot assume that sex without contraception is the same as the desire to conceive. In their study of infertility service use and unmet need using the National Survey of Family Growth, Stephen and Chandra (2000, p. 133) classified partnered women as "infertile" based on the 12-month medical definition but noted that this was imperfect because they could not account for certain "social bases to infertility [...] the desire to become pregnant [...]." Greil et al. (2016) showed that adding the requirement that medically infertile women desire to have a child reduces estimated need for infertility services by 15.9%.

In the National Survey of Fertility Barriers (NSFB), less than half (48.2%) of women who met the medical criteria for infertility said they were trying to conceive. The other 51.8% reported having had unprotected intercourse without conception but were not trying to conceive (Greil et al. 2010). Therefore, only around half of women who were medically infertility had subjective intentions that might prompt them to view inability to conceive as a problem. Recent studies using the NSFB have analyzed the role of intentions to conceive when experiencing an episode of infertility, classifying women broadly as "infertile with intent" and "infertile without intent." The former are more likely to seek medical help, pursue treatment, (Greil and McQuillan 2004), and self-identify as having a fertility problem (Johnson and Fledderjohann 2012). Greil et al. (2010) described those *without* intent as the "hidden infertile": they do not fit the profile of women who are intensely distressed and committed to seeking treatment, and are less likely to come to the attention of clinicians. This hidden group can be partially explained by race and class differences in pregnancy "planfulness." Bell's (2014) work on infertility among lower SES women emphasizes how pregnancy intent in current research implies "conscious action" to carry out that intent. For lower SES women, however, Bell observed that the idea of planning the timing and number of pregnancies was quite alien given their broader lack of reproductive and lifecourse control.

Fertility intentions may play a role in influencing how people respond to infertility, yet infertility also potentially impacts fertility intentions and ideal/actual family size. Some women may experience heightened desires to have a child if conception takes too long; others may decide to forgo pregnancy or downgrade their ideal family size. To date, there are no longitudinal U.S. studies that thoroughly address how fertility intentions change in response to experiences of infertility, although some studies imply connections (Freda et al. 2003; Shreffler et al. 2016).

The Role of Men in Reproduction

A third shared topic is the role of men in reproduction. Although we examine women in our empirical example below, we address this here as a fruitful area for future integration. Both fertility and infertility research focus primarily on women, who have often been considered more central to, and concerned about, reproduction (Agadjanian 2002; Almeling and Waggoner 2013; Goldscheider and Kaufman 1996; Fennell 2011; Greene and Biddlecom 2000). More practically, women were often more reliable reporters of births, more likely to be home to answer surveys, and able to accurately describe their husband's fertility goals (Goldscheider and Kaufman 1996; Rendall et al. 1999). Demographic changes, men's weakening connection to their families due to non-marital births and marital disruption, multiple partner fertility, and understanding how fertility intentions is shaped by gendered power dynamics have all led to calls to include men in studies of fertility and family planning (Dodoo and Frost 2008; Forste 2002; Greene and Biddlecom 2000).

Infertility researchers have often assumed that men do not want to participate in studies because male infertility is stigmatized (Lloyd 1996; Barnes 2014; Miall 1986). Carmeli and Birenbaum-Carmeli (1994), however, underscored how men are marginalized because of the medical focus on women's bodies. Thus, in infertility research there has also been a call to study men directly, as individuals or partners. Notably, a fecund woman will meet the 12-month medical definition if she partners with an infertile man. The dyadic nature of reproduction requires us to account for the interplay between partners' fecundity statuses.

Toward a More Holistic Reproductive Framework

From Reproductive Events to Reproductive Careers

How can we conceptually integrate fertility and infertility into a more holistic framework? We argue here that a "reproductive career" approach can extend existing lifecourse approaches by encompassing reproductive events beyond fertility. By a reproductive careers approach, we mean explicitly accounting (empirically or theoretically) for how an individual's reproductive past shapes present/ future reproductive expectations and behaviors.

Morgan and Taylor (2006, p. 384) described the lifecourse perspective "as the unquestioned, appropriate analytic frame for contextualizing fertility intentions and behavior." The basic premise is: "events and their circumstances at time *t* can influence behavior at time *t* + 1" (Morgan and Hagewen 2006: 230). The lifecourse paradigm draws on five key principles: (1) human development is a lifelong process; (2) individuals have both agency and constraints in constructing their lifecourse; (3) individual lifecourses are embedded in both time and place (i.e., they are historically and socially contingent experiences); (4) transitions, events, and behaviors can differ across different individuals; and (5) "lives are lived interdependently" (Elder et al. 2003, p. 13). Despite widespread acceptance of this paradigm in both fertility and infertility research (Exley and Letherby 2001; Morgan and Hagewen 2006), there is still a strong tendency to analyze reproductive events in isolation. In/fertility researchers can start by acknowledging that all reproductive events are embedded in larger reproductive careers across the lifecourse.

The concept of a "career" is well known in social science research starting with Becker's (1973) work on deviant careers. Careers are a "sequence of movements from one position to another in an occupational system made by any individual who works in that system" (Becker 1973, p. 24). They include the idea of contingency: "factors on which mobility from one position to another depends" (Becker 1973, p. 24). Social scientists have investigated a variety of careers: illness, marriage, and occupations, among others (Aldous 1978; Aneshensel 2013; Blumstein 1986; McKinlay 1971; Moore and Hayward 1990; Pescosolido 1991). There are some references to reproductive, fecund,

or fertility careers in the demographic literature, but these typically refer to the biological reproductive lifespan (Bulatao and Fawcett 1983). Harpending (1994) defined a woman's reproductive career as the amount of time a woman spends in each of the four states: pregnancy, lactation, sterility, and being at risk of any of the former three states. Davis (1998) defined men's reproductive careers as the average time between first and last recorded births of biological offspring. Thus, overwhelmingly when reproductive career is used in fertility research, it refers to the biological reproductive lifespan. One notable exception is Boldt and Latif's (1977) "contraceptive career." Drawing on the symbolic interaction tradition in sociological theory (Blumer 1969; Mead 1934), they advanced a stage model of contraceptive use: (1) awareness, (2) interest, (3) decision to initiative, (4) assessment of acceptability/effectiveness, and (5) decision to continue. They argued that understanding of these stages required examining three distinct elements of careers, identified by Stebbins (1970): the career line (sequence of events), the objective career (descriptive movement through the various stages), and the subjective career (subjective interpretation of each stage and overall movement through the career line). Working more broadly in the sociology of reproduction, Bessett (2010) described the concept of a *stigmatized reproductive career*—a history of reproductive events that violated normative understandings of gender and motherhood, e.g., abortion—and showed how that history negatively influenced women's interactions with medical professionals when they conceived a wanted pregnancy.

Building on Boldt and Latif's (1977) and Bessett's (2010) work and the rich, prior sociological research on careers (Aldous 1978; Aneshensel 2013; Becker 1973; Blumstein 1986; McKinlay 1971; Pescosolido 1991), we promote a two-part meaning of the reproductive career: (1) the timespan of biological and social reproductive processes (i.e., the time-span during which an individual or couple builds their family through various biological and social means); and (2) the contingent and connected nature of past, present, and future reproductive experiences, attitudes, and behaviors. We emphasize understanding both the objective movement of individuals through their reproductive career, and the subjective responses to a particular reproductive experience (e.g., distress over an adverse reproductive event, decreased or heightened fertility desires in response to an unanticipated reproductive event).

Some research has begun to explore the contingent nature of reproductive events. Women who experience secondary infertility (delayed conception subsequent to a live birth, not including brief postpartum infecundity) are less distressed and less likely to seek medical help compared to women with primary infertility (Greil et al. 2011). Thus, experiencing infertility after a live birth changes its subjective meaning and response behaviors. Women who experience miscarriage after initial infertility may be less hopeful about future fertility plans (Freda et al. 2003) and more distressed (Shreffler et al. 2011). Other research on wanted pregnancy following induced abortion shows that these past reproductive events can heavily impact women's subsequent pregnancy experiences and encounters with medical professionals (Bessett 2010). These studies emphasize the contingent nature of women's future reproductive events and experiences on prior ones. Other work has developed ways to understand what are often viewed as disparate events. Shirani and Henwood (2011) found that men who had delayed conception and men whose partners had unplanned pregnancies both experienced threats to their lifecourse expectations and personal identities. Maximova and Quesnel-Vallee (2009) conceptualized *unintended events* —birth or childlessness—as potentially distressing and also found gender differences in distress associated with these events. This prior work supports the conceptual utility of a reproductive careers approach to better articulate the connections between disparate reproductive events across the lifecourse.

Measuring and Modeling Reproductive Careers

Simple empirical analysis shows support for a reproductive career approach. The NSFB dataset includes a range of information about US women's reproductive histories, including time it took to conceive each pregnancy (months), orientation toward the pregnancy (intended, unintended, ambivalent), and various pregnancy outcomes (live birth, miscarriage/stillbirth, abortion). The dataset also includes a series of questions to establish social pathways to parenthood (fostering, adoption, step-parenting) in addition to biological parenting. We created a cross-tabulation of these different reproductive variables (Table 3). Column 1 displays how many women total in the NSFB have experienced each reproductive event, e.g., 85% have ever been pregnant and 80% have ever had a live birth. Notably, 47% have *ever* experienced

Table 3. Percent of women with overlapping reproductive experiences: distributions from the United States.[a]

	NSFB total %	*Pregnancy %*	*Live birth %*	*Infertility[b] %*	*Childless (bio) %*	*Childless (bio/soc) %*	*Unwanted pregnancy %*	*Miscarry/ stillbirth %*	*Abortion %*
Pregnancy	85	–	100	91	23	21	100	100	100
Live birth	80	94	–	85	0	0	92	92	79
Infertility	47	50	50	–	37	32	54	58	61
Childless (bio)	19	5	0	15	–	100	7	8	21
Childless (bio/soc)	16	4	0	11	86	–	7	6	17
Unwanted pregnancy	37	44	43	43	15	15	–	54	92
Miscarry/stillbirth	27	32	31	33	11	10	39	–	33
Abortion	11	12	10	14	12	11	26	13	–
Column *n*	4707	3797	3490	2403	1174	1009	1717	1530	563

a. Weighted for sampling design and population weights
b. 12-month medical definition

12-month infertility, thus infertility affected nearly half of all NSFB respondents at some point in their lifecourse.

Looking within women who have ever been pregnant (Column 2), 94% have had a live birth, 50% have also experienced an infertility episode, 5% are biologically childless, 4% are biologically and socially childless (i.e., no children via biological or social pathways), 44% have experienced unwanted pregnancy, 32% have had a miscarriage/ stillbirth, and 12% have had an abortion. This simple cross-tabulation analysis shows how women's reproductive experiences cannot be fully captured by looking at a series of discrete outcomes. If we look at women who have ever experienced 12-month infertility (Column 4), 91% have ever been pregnant and 85% have had a live birth. Notably, 43% of these women have also experienced an unwanted pregnancy, and 14% reported an abortion in their reproductive history. Therefore, dichotomizing women as having or not having a live birth, or achieving pregnancy versus experiencing infertility, conceals a range of other events that may influence their reproductive attitudes and behaviors.

How do we start to think about modeling these interconnections? In other analyses of NSFB data, Johnson et al. (2018) created overall measures of women's reproductive careers, focusing on two basic dimensions: *density* (overall frequency/ concentration of reproductive events within a certain time period) and *complexity* (number of distinct event types). Density was a simple sum of reproductive events:

Pregnancies
+ # Abortions
+ # Miscarriages/Stillbirths
+ # Live births
+ # Infertility episodes

Complexity was a count of the distinct types of events experienced:

Any intended pregnancies
+ Any unintended pregnancies
+ Any ambivalent pregnancies
+ Any abortions
+ Any miscarriages/stillbirths
+ Any live births
+ Any infertility episodes

Using density and complexity as outcome measures, the authors found that Black and Hispanic women and lower SES women had both denser (more frequent reproductive events) and more complex (greater number of distinct types of events) reproductive careers compared to their race- and class-advantaged peers, controlling for other demographic and attitudinal variables. The findings provided support for the notion that there is not simply a race/class disparity in the burden of unwanted or mistimed pregnancy (Sweeney and Raley 2014), but that race/ class disparities are more pervasive throughout women's reproductive careers and likely connected to marginalized women's decreased ability to exert control over their reproductive outcomes.

Measures of density and complexity create overall summaries of reproductive histories, but what if we want to examine the patterns themselves in greater detail? One innovative methodological tool that might be used here is sequence analysis (SA). As a methodological orientation, SA is an umbrella term for techniques that emphasize sequential or time-dependent processes, such as survival analysis and latent trajectory analysis. SA is also a stand-alone technique used in the life sciences and slowly gaining use in the social sciences (Abbott and Tsay 2009). SA can be conducted on any dataset that provides "an ordered list of elements" that is converted into sequences

for each observation or case (Brzinsky-Fay et al. 2006). The ultimate goal is to empirically estimate the most common or dominant sequences through data reduction techniques such as cluster analysis; these can be visualized graphically for descriptive analysis or turned into independent or dependent variables in statistical models (see e.g., Elzinga and Liefbroer 2007; Fillieule and Blanchard n.d.). By applying SA to reproductive history data, we could envision being able to answer such questions as: What are the dominant profiles of reproductive careers, including both individual and dyadic/ linked careers of partners? How do they vary by subgroups (e.g., gender, race, class, union status)? How are different reproductive career trajectories associated with (future) fertility intentions and behaviors? Empirically showing these different profiles could provide a powerful tool for future research.

One concern is whether we have data that can fit these conceptual and methodological tools. Reproductive careers and SA assume that we have good-quality longitudinal data or comprehensive, retrospective data from cross-sectional surveys. This level of data quality and comprehensiveness is hard to achieve in contemporary surveys due to high non-response rates (Sax et al. 2003), attrition between survey waves (Chatfield et al. 2005), missing data (Little and Rubin 2014), and problems with reporting accuracy or recall (Bhandan and Wagner 2006; Schroder et al. 2003). All surveys are plagued to some extent by each of these problems. Missing data is a common issue with social science data; however, SA is actually quite robust to certain types of missing information as long as variables can generally be organized into an overall timeline. For example, the NSFB asks women to report on up to ten pregnancies in their history (dates, time to conception, outcome, and intendedness). If a woman had three pregnancies, but did not provide specific dates, we could still know the order of the pregnancies, as well as the other characteristics, to organize them into a sequence. Different surveys also offer differing advantages. For example, the National Survey of Family Growth (NSFG) is frequently deployed by scholars for U.S. fertility analyses because it offers repeated cross-sectional samples starting from 1973, has a substantial sample capable of analyzing various subgroups, has a high response rate for recent datasets (73%) because of the in-person interviewing strategy (NCHS 2016), and detailed sexual and reproductive histories. The NSFB is smaller and has less detailed reproductive histories, but

it includes two waves of data on the same sample of women, has a matched partner sample for a subset of respondents, and has a range of psychosocial variables about both fertility and infertility. Harmonizing datasets is one promising way to take advantage of the benefits of differing surveys, although it also has more intense computational requirements (Burkhauser and Lillard 2005; Hayford et al. 2014). Researchers do need to be realistic about data limitations, but the reproductive careers approach and SA can be utilized even with imperfect data.

Conclusion

To researchers deeply immersed in either tradition, fertility and infertility appear to be separate phenomena with different scholarly audiences, theoretical frameworks, definitions, and motivations for research. Additionally, while infertility research often takes failed fertility as its *raison d'être*, fertility research has only minimally and indirectly addressed infertility. Yet population-based studies of responses to infertility make more sense when considering fertility intentions, and fertility intentions may be shaped by both lived and anticipated experiences of infertility. Additionally, changes in fertility intentions and plans over time are better understood within the context of more complex reproductive careers. Understanding how fertility and infertility may be dynamically interrelated over the reproductive years for many people can enrich each research tradition. For many contemporary questions, creating a more integrative research agenda is mutually beneficial, drawing together different theoretical and methodological strengths, and allowing for researchers to develop fruitful new research questions and expand existing theories and concepts.

To move toward integration, we outlined three common conversations across the two bodies of research: changing fertility trends, fertility intentions, and the role of men in reproduction. We also suggested that more conceptual integration is possible via a reproductive careers approach as an extension of the existing lifecourse paradigm. While the concept of the "reproductive career" is already used in some reproductive research, we argued that its usage could be expanded to account for dual meanings: (1) the career as a timespan for biological and social reproductive behaviors, and (2) the career as a sequence

of movements involving contingencies. If we think about reproductive careers in terms of these dual meanings, then prior reproductive events affect subsequent reproductive events, be they fertility, infertility, childlessness, childfree, or a host of other possible outcomes. These other reproductive events, typically ignored when we focus on one topic in isolation, become highly relevant for present/future experiences within a reproductive career framework.

Conceptualizing dynamic reproductive careers raises new questions for fertility and infertility researchers. Under what conditions do various reproductive experiences contribute to changes in lifetime fertility intentions and outcomes? Do assisted reproductive technologies alter fertility intentions and actual fertility rates? Should the measurement of fertility intentions take perceptions of infertility into account? If individuals express ambivalent fertility intentions, can they truly experience infertility? These are only some of the questions that emerge when we position the analysis of both fertility and infertility in a wider reproductive career framework.

Acknowledgments — An earlier version of this paper was presented at the 2011 NCFR Theory Construction and Research Methodology Workshop.

Funding — This research was supported in part by a Grant from NICHD [R01-HD044144 "Infertility: Pathways and Psychosocial Outcomes" (Lynn White and David Johnson, Co-PIs)].

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